WHAT IS CLAIMED IS:

1.   1.   A system for direct mesh manipulation of a mesh model

2. comprising:

3.   a computer system, wherein said computer system includes a memory,

4. a processor, a user input device and a display device;

5.   a computer generated geometric model stored in said memory of said

6. computer system, wherein said model is in a computer-aided design (CAD)

7. format; and

8.   a user using the computer system to convert the CAD model into a

9. mesh model, evaluate the mesh model using a computer-aided engineering

10. (CAE) analysis, modify a predetermined design criteria, and update the mesh

11. model by direct mesh manipulation using Dirichlet parameter distribution to

12. determine deformation of a surface of the mesh model, so that the updated

13. mesh model is available for further study.

1.   2.   A system as set forth in claim 1 wherein the computer system

2. includes a knowledge-based engineering library and the geometric model is

3. stored in the knowledge-based engineering library.

1.   3.   A system as set forth in claim 1 wherein the computer system

2. updates the mesh model using direct mesh manipulation, wherein a surface is

3. modeled as a linear elastic sheet to determine deformation of the surface of the

4. mesh model.

1   4.   A system as set forth in claim 1 wherein the computer system

2   updates the mesh model using direct mesh manipulation, by modeling a surface

3   as a lattice structure to determine the deformation of the surface.

1   5.   A method of direct mesh manipulation of a mesh model, said

2   method comprising the steps of:

3   selecting a geometric model, wherein the model is in a computer-aided

4   design (CAD) format;

5   converting the CAD model into a mesh model;

6   evaluating the mesh model using a computer-aided engineering (CAE)

7   analysis;

8   determining whether to vary a design criterion;

9   modifying the predetermined design criterion, if determined to vary a

10   design criterion;

11   updating the mesh model to include the modified design criterion using

12   direct mesh manipulation (DMM) of the mesh model, wherein a surface of the

13   mesh model affected by the modified design criterion is described using a

14   Dirichlet parameter distribution to determine a displacement of the surface;

15   modifying the feature surface of the mesh model by the displacement;

16   and

17   using the updated mesh model.

1   6.   A method as set forth in claim 4 wherein said step of updating a

2   mesh model includes the steps of:

3   bounding a feature on the surface of the model with a closed curve;

4   defining an influence center for the feature;

5   modifying a mesh for the feature to include a node at the influence

6   center; and

7   applying the Dirichlet parametric distribution to the mesh of the feature

8   to determine displacement of each node within the feature.

1   7.   A method as set forth in claim 6 including the step of using

2   finite element analysis to determine the displacement from the Dirichlet

3   parametric distribution.

1   8.   A method as set forth in claim 6 wherein the maximum

2   displacement of the surface is at the influence center.

1   9.   A method of direct mesh manipulation of a mesh model, said

2   method comprising the steps of:

3   selecting a geometric model, wherein the model is in a computer-aided

4   design (CAD) format;

5   converting the CAD model into a mesh model;

6   evaluating the mesh model using a computer-aided engineering (CAE)

7   analysis;

8   determining whether to vary a predetermined design criterion;

9   modifying the predetermined design criterion, if determined to vary the

10   design criterion;

11   updating the mesh model to include the modified design criterion using

12   direct surface manipulation (DMM) of the mesh model, wherein a surface of

13   the mesh model is described as an elastic sheet and linear elastic finite element

14   analysis is applied to determine displacement of the surface;

15   modifying the surface of the mesh model by the displacement; and

16   using the updated mesh model.

1   10.   A method as set forth in claim 9 wherein said step of updating

2   the mesh model includes the steps of:

3   bounding a feature on the surface of the model with a closed curve;

4   defining an influence center for the feature;

5   modifying a mesh for the feature to include a node at the influence

6   center;

7   describing the deformed feature as a linear elastic sheet that is

8   stretched; and

9   determining the displacement of each node in the mesh of the feature

10   using linear elastic finite element analysis.

1   11.   A method as set forth in claim 10 wherein the maximum

2   displacement of the surface is at the influence center.

1   12.   A method of direct mesh manipulation of a mesh model, said

2   method comprising the steps of:

3   selecting a geometric model, wherein the model is in a computer-aided

4   design (CAD) format;

5   converting the CAD model into a mesh model;

6   evaluating the mesh model using a computer-aided engineering (CAE)

7   analysis;

8   determining whether to vary a predetermined design criterion;

9   modifying the predetermined design criterion, if determined to vary the

10   design criterion;

11   updating the mesh model to include the modified design criterion using

12   direct surface manipulation (DSM) of the mesh model, wherein a surface of the

13   mesh model is embedded within a lattice structure having a volume, a point

14   within the volume is modified, and finite element analysis is applied to

15   determine displacement of each node within the lattice,

16   modifying the surface of the mesh model by the displacement; and

17   using the updated mesh model.

1   13.   A method as set forth in claim 12 wherein said step of updating

2   the mesh model includes the steps of:

3   bounding a region of the mesh containing the surface with a lattice;

4   determining a position of a node for the mesh with respect to the lattice

5   boundaries;

6   deforming a lattice point a predetermined displacement;

7   using linear elastic finite element analysis to determine displacement of

8   the lattice point; and

9   determining displacement of mesh nodes within the lattice to maintain

10   their position with respect to the lattice boundary using linear elastic finite

11   element analysis.

1   14.   A method as set forth in claim 13 wherein said lattice point is a

2   corner point of the lattice structure.

1   15.   A method as set forth in claim 13 wherein the lattice point is a

2   point within the interior of the lattice.